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B60R 21/16

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B7B BSB

(56) Documents Cited
GB 2257952 A **GB 2257950 A** **EP 0686527 A1**
US 5094477 A

(58) Field of Search
UK CL (Edition O) **B7B BSB**
INT CL[6] **B60R 21/16**
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(54) Folding an airbag inside-out into a triangular breakable seam between the top and bottom layers of the bag

(57) An air-bag 1 comprises two super-imposed layers of fabric 2,3 which are inter-connected by weaving the top and bottom layers to form a peripheral seam 4, there being a central aperture 12 in one of the layers of fabric 2 to receive a gas generator. The two layers of fabric are inter-connected by a breakable seam 9,10,11 which define a triangular region. The bag is turned inside-out through the aperture, the triangular seam defining the exterior of the inverted bag, each apex of the triangle is subsequently folded inwards to form a hexagon or triangle.

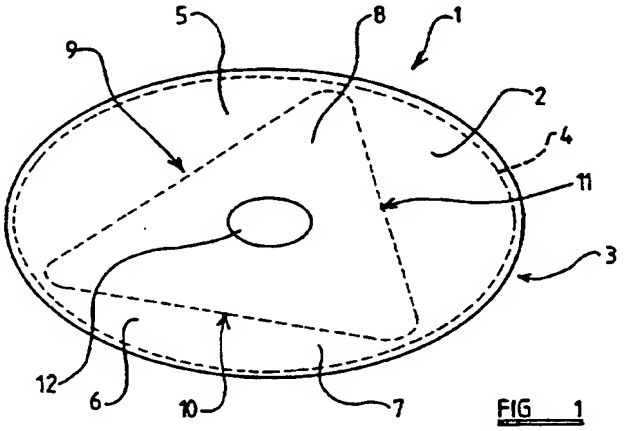

FIG 1

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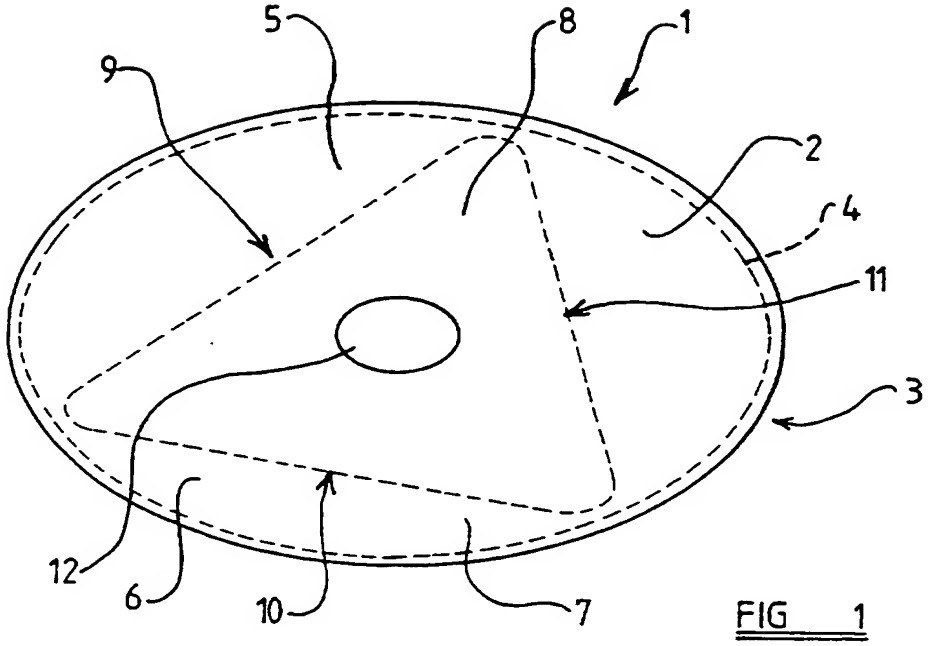

FIG 1

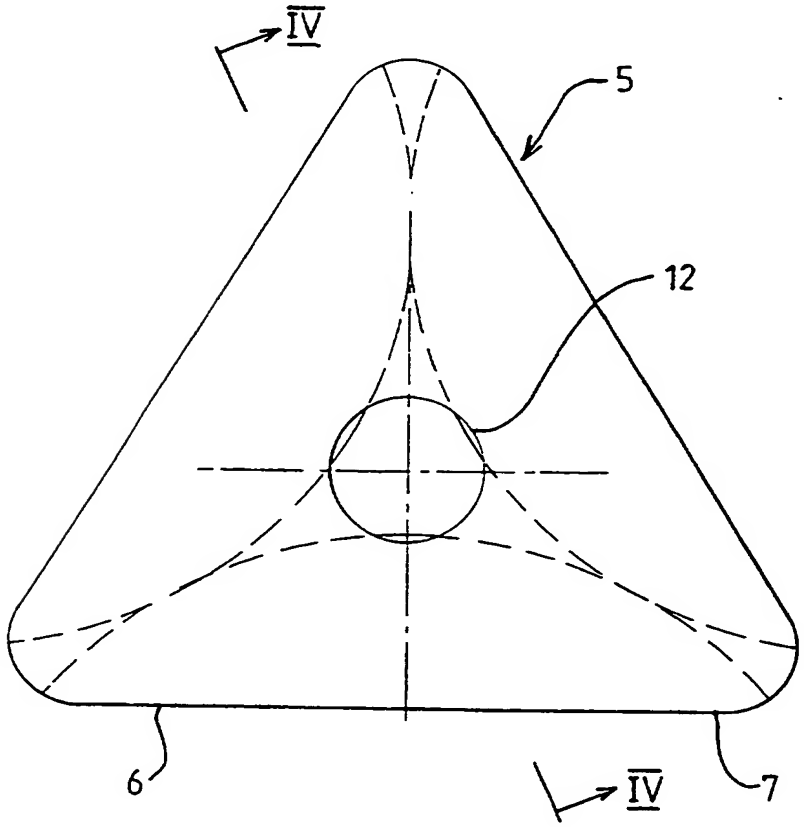

FIG 2

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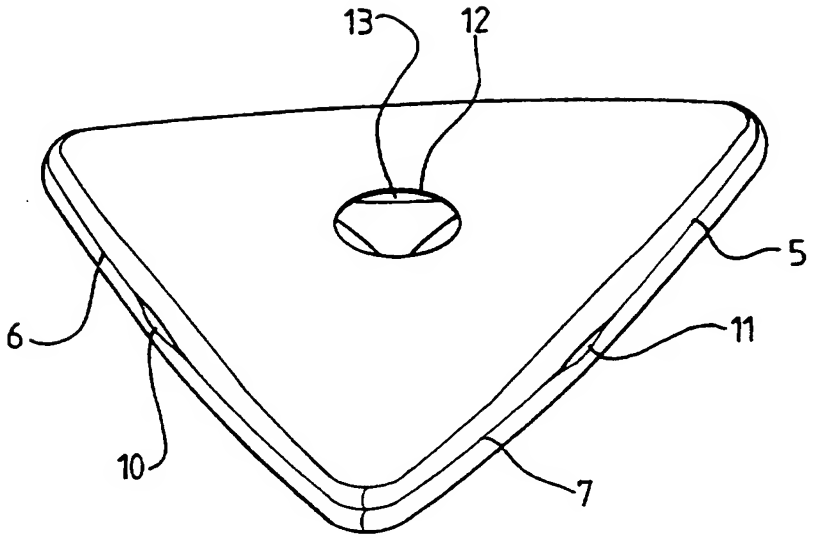
FIG 3



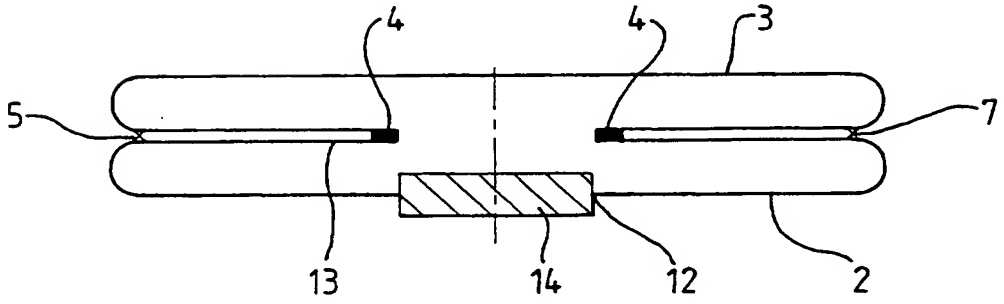


FIG 4

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FIG 5

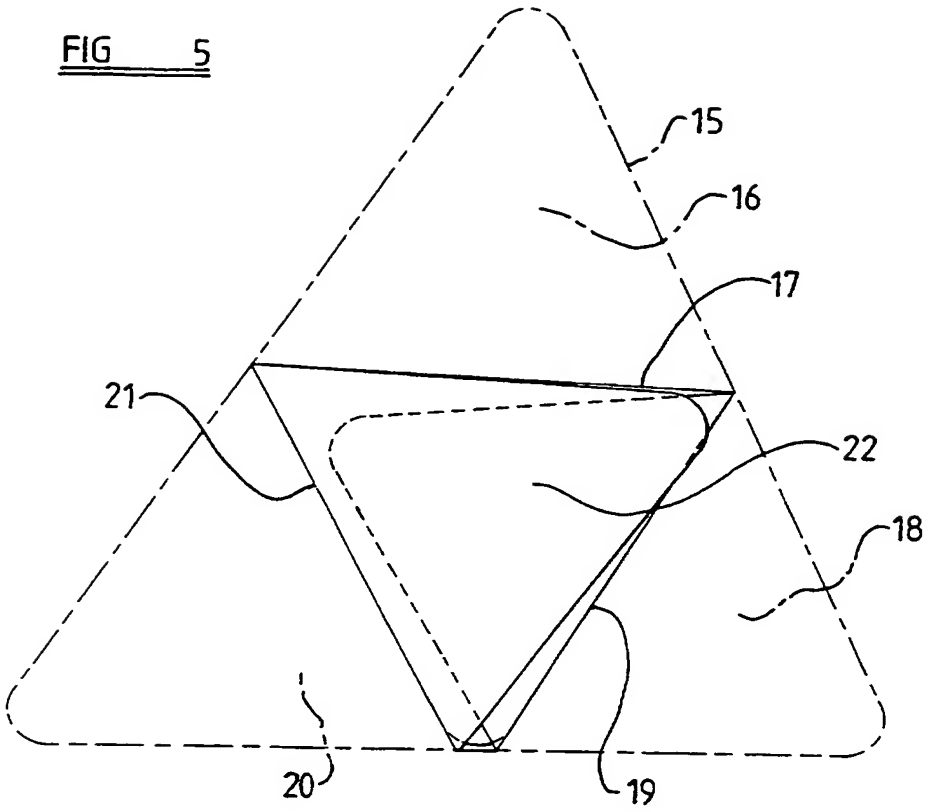
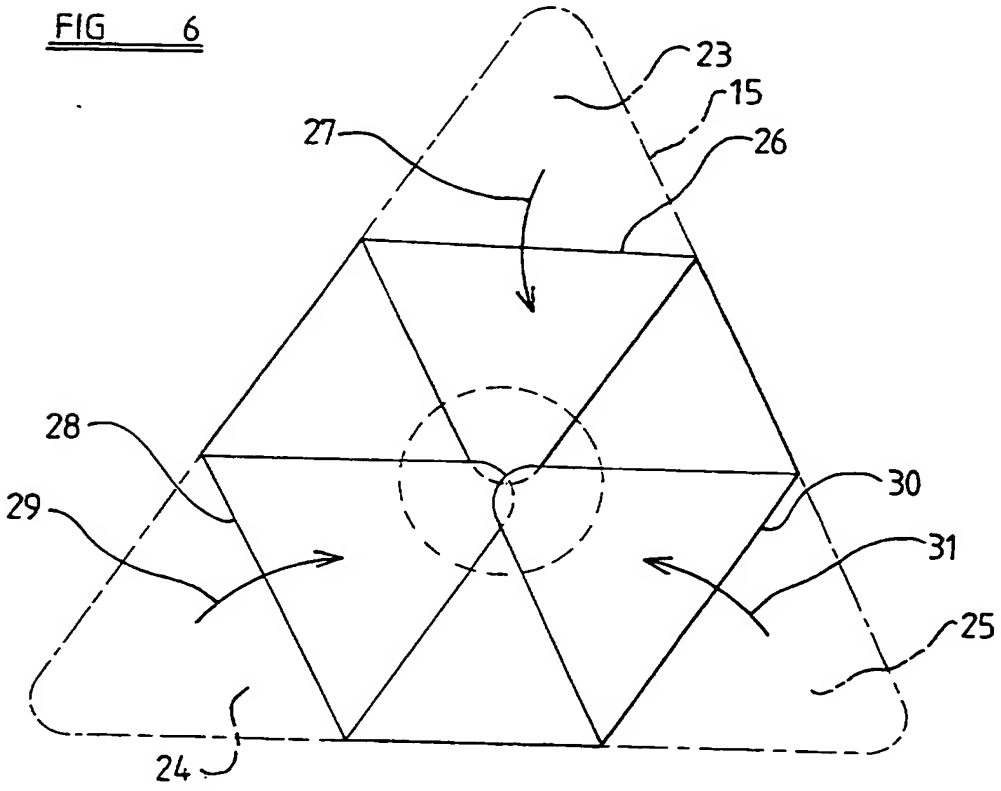


FIG 6



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DESCRIPTION OF INVENTION

"IMPROVEMENTS IN OR RELATING TO A TRIANGULAR FOLDING BAG"

THE PRESENT INVENTION relates to an air-bag.

A typical air-bag is intended to be mounted on a motor vehicle, and is associated with a gas generator which is adapted to inflate the air-bag in the event that an accident should arise, the inflated air-bag then being positioned to provide protection for the driver or other occupant of the vehicle.

Air-bags may be of many different shapes. A conventional air-bag adapted to be mounted in the hub of a steering wheel is circular, when the bag is un-inflated, and substantially spherical when the bag is inflated. Other air-bags may have different shapes.

A typical air-bag is stored, in a folded state, in a housing. The housing protects the air-bag, to minimise the risk of the air-bag being damaged in any way, both during storage and during inflation.

It is difficult to fold a circular or irregularly-shaped air-bag, so that the air-bag will fit snugly within the housing.

The present invention seeks to provide an improved air-bag.

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According to this invention there is provided an air-bag, the air-bag comprising two super-imposed layers of fabric, the layers of fabric being inter-connected by means which define the outer periphery of the air-bag when in the unfolded state, one layer of fabric being provided with an aperture which is adapted to receive a gas generator, or means connected to a gas generator, there being a breakable seam inter-connecting the upper and lower layers of the fabric, said breakable seam defining a substantially triangular area which surrounds said aperture, the breakable seam incorporating at least one space between adjacent parts of the breakable seam.

Preferably the breakable seam is defined from a plurality of seam portions, there being a plurality of spaced between said adjacent seam portions.

Conveniently the breakable seam portions comprise three seam portions, each seam portion being of substantially "V"-shape.

Advantageously the seam portions define three linear sides of said triangular area, there being a space provided in the seam portions between the ends of each linear side of the triangular area.

Conveniently the means which define the outer periphery of the bag comprise a peripheral seam, the peripheral seam and said breakable seam being formed simultaneously with the weaving of the fabric, threads from the upper and lower layers of fabric being inter-woven to form the peripheral seam and relatively weak threads, provided in at least one of the fabric layers, being inter-woven with the threads of the other of the fabric layers to form the breakable seam.

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The invention also relates to a method of folding an air-bag comprising the steps of taking an air-bag as described above, turning the air-bag inside-out so that the air-bag has a triangular configuration defined by the shape of the breakable seam, and subsequently folding the air-bag with linear folds.

Conveniently the method comprises the subsequent steps of folding inwardly, towards the centre of the triangular configuration, flaps formed by the corner regions of the bag when in said triangular configuration.

Preferably the flaps are folded inwardly about fold-lines, which fold-lines define the periphery of an area which is of triangular form and which has a shape and size corresponding substantially to the shape and size of each said flap.

Conveniently the flaps are folded inwardly about fold-lines, each flap being of such a size that the distance between the fold-lines of the flaps, along the sides of the bag when in said triangular configuration, is substantially equal to the length of each fold-line, the flaps thus being folded into a region which is substantially hexagonal.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a perspective view of an air-bag in accordance with the invention prior to the commencement of folding,

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FIGURE 2 is a plan view of the air-bag of Figure 1 after commencement of the folding process,

FIGURE 3 is a perspective view of the bag in the condition shown in Figure 2,

FIGURE 4 is a sectional view of the bag as shown in Figure 2, taken on the line IV-IV of Figure 2.

FIGURE 5 is a plan view illustrating a further step in the folding process, and

FIGURE 6 is a plan view corresponding to Figure 5 illustrating an alternative further step in the folding process.

Referring initially to Figure 1, a circular air-bag is illustrated. This air-bag is intended to be mounted in the hub of a steering wheel, to provide protection for the driver of the vehicle. The air bag 1 is made of two superimposed layers 2,3 of fabric. The layers 2,3 of fabric may be woven simultaneously as a double-layered web, with parts of the web being inter-connected to form seams. This may be accomplished by, in selected areas of the web, weaving threads from one of the layers of fabric into the other of the layers of fabric. This technique is disclosed in WO 90/09295.

As can be seen from Figure 1, the upper layer of fabric 2 is secured to the lower layer of fabric 3 by means of a circular seam 4 which is located adjacent the edge of the air-bag. The seam 4 is of substantial strength and is intended to maintain the integrity of the air-bag when it is subsequently inflated.

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Three further seams 5, 6, 7 are provided, each of these seams being of "V"-shaped configuration. The three seams define a triangular area 8. The threads used to form the further seams 5, 6, 7 are threads which are present for the purpose in one, or both of the layers of fabric and are relatively weak since, as will become apparent from the following descriptions, the seams 5, 6, 7 are intended to break when the bag is inflated. In contrast, the peripheral circular seam 4 is made to be relatively strong.

Small spaces, 9, 10, 11 exist between the adjacent co-aligned ends of the further seams 5, 6, 7. The small spaced 9, 10, 11 are each located substantially at the middle of a linear side of the triangular area 8, as defined by the further seams 5, 6, 7.

A circular aperture 12 is formed in the upper layer of fabric 2. It can be seen that the centre of the aperture 12, the centre of the triangular area 8 and the centre of the circular bag 1 are all co-incident. The aperture 12 is intended to receive a gas generator.

The first step in the process of folding the bag illustrated in Figure 1 comprises the step of turning the bag inside-out. This is accomplished by passing the whole of the bag through the aperture 12. The bag then has the form illustrated in Figures 2 and 3.

When the bag is turned inside-out the bag has a triangular configuration defined by the further seams 5, 6, 7. As can be seen, the aperture 12 is visible, and the triangular configuration of the exterior of the bag is defined by the further seams 5, 6, 7. The small spaces 10 and 11 are visible in Figure 3. Through the aperture 12 can be seen parts 13 of the bag that initially, as shown in

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Figure 1, lay outside the triangular area 8. These parts are now contained within the envelope defined by the inside-out bag. There is a space that is present between the now inwardly directed peripheral parts of the bag which can receive part of a gas generator which is inserted into the inside-out bag through the aperture 12.

Figure 4 is a diagrammatic cross-sectional view of the bag illustrating a gas generator 14 associated with the aperture 12 formed in the layer of fabric 2. The other layer of fabric 3 is visible together with the further seams 5 and 7 and the peripheral, relatively strong seam 4. The inwardly folded parts of the bag 13 contained within the interior of the inside-out bag can also be seen lying adjacent the gas generator 14.

Referring now to Figure 5, the bag 1 is viewed in plan, at a subsequent stage during the folding process.

It is to be appreciated that since the bag has a triangular outer periphery following the stage in which the bag is turned inside-out, the bag can be relatively easily folded.

If the folding technique that is illustrated in Figure 5 is utilised, the three corner regions of the triangle 15 defined by the bag are considered to be three corner flaps of equal area, each flap being of triangular form. In order to fold the bag, a first corner flap 16 is folded downwardly about a fold-line 17, and subsequently a second corner flap 18 is folded inwardly about a fold-line 19. Finally, a third corner flap 20 is folded in about a fold-line 21. All three corner flaps 16, 18, 20 are thus super-imposed and lie within a triangular area bounded by the fold-lines 17, 19, 21. These fold-lines

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define a triangular area 22 which is of an equivalent shape and size to that of each of the corner flaps 16, 18, 20.

The technique used to fold the triangular bag 15 may be used again to further fold the bag, the triangular bag 22 having flaps, formed by the corners of the triangle, folded inwardly.

Figure 6 illustrates an alternative technique for folding the triangular bag 15. Again, three flaps 23, 24, 25 are folded inwardly from the corners of the triangle, but the flaps in the method used in Figure 6 are rather smaller than the flaps used in the method illustrated in Figure 5. Thus, the flap 23 is folded inwardly about a fold-line 26 as indicated by the arrow 27. Subsequently, the flap 24 is folded inwardly about a fold-line 28 as indicated by the arrow 29. Finally, the flap 25 is folded inwardly about a fold-line 30 as indicated by the arrow 31. The bag, when folded in this way, has a substantially regular hexagonal outer shape. Thus, the distance along the sides of the original triangle 15 between the fold-lines 26, 28 and 30 is equal to the length of each of the fold-lines.

It is to be understood that the gas generator 14 is adapted to inject the gas into the bag through the aperture 12. When the bag is inflated, gas will flow into the space between the upper fabric 2 and the lower fabric 3 in the area 8, thus tending to commence the deployment of the bag.

As the bag inflates, gas will pass through the small spaces 9, 10, 11 between the seams further 5, 6 and 7, and consequently, gas will be introduced into the region of the bag defined by the fabric layers 2 and 3 outside the

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triangular area 8. The seams 5, 6 and 7 are designed to be relatively weak, so that the seams will split or separate during the inflation process. This splitting or separating commences at the ends of the seams adjacent the small spaces 9, 10 and 11. If the breakable seam were an unbroken triangular seam, the splitting or separating might not commence smoothly and predictably.

The threads which extend between the upper layer of fabric and the lower layer of fabric will snap in the seams 5, 6 and 7, causing disintegration of the seams, whilst retaining the integrity of the upper fabric layer 2 and the lower fabric layer 3, so there is no gas leakage through the fabric layers in the region of the seams.

Initially the central part of the bag, i.e. the part of the bag defined by the area 8 is inflated. Axial movement of the part of the bag opposite the aperture 12 terminates as the seams 5, 6 and 7 begin to break. Subsequently, the radially outer part of the bag on the exterior of the area 8 is inflated, thus urging the peripheral edge seam 4 of the bag radially outwardly. Finally, the part of the bag opposite the aperture 12 continues its axial movement away from the aperture as the bag becomes fully inflated. The speed of movement of the part of the bag opposite the aperture 12 is thus relatively low as the bag becomes fully inflated, consequently reducing the risk of the bag itself injuring the occupant of the vehicle that the bag is intended to protect.

When the bag is fully inflated, it will be appreciated that the peripheral seam 4 is located in such a position that the free edges of the fabric sheets ar located on the interior of the bag and not on the exterior of the bag. The free edges of the fabric can be relatively

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"sharp" and could inflict an injury on an occupant of the vehicle. However, since the free edges are located on the interior of the bag, the free edges are not in a position to inflict any injuries on occupants of the vehicle.

Whilst the invention has been described with reference to one embodiment in which the bag is a circular bag, it is to be appreciated that the invention may be applied to bags of other shapes, such as oval bags.

It is to be appreciated that a bag having a triangular shape at an early stage in the folding process provides various advantages in that the overall folding technique is very straightforward, simply involving the folding inwards of flaps provided at the corner regions of the bag. With the flaps folded inwardly, it is to be understood that the gaps or spaces 9, 10, 11 between the seams are located on the periphery of the relatively small area defined by the bag when the flaps have been folded inwardly. Consequently, during the initial stage of inflation of the bag, a very high pressure is exerted in the region of the bag where the spaces between the ends of the breakable seams are located. This can lead to a very easy commencement of the breaking of the breakable seam.

A bag which, when fully folded, has a triangular or hexagonal shape may fit very conveniently within the space available in a housing provided at the centre of a steering wheel.

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CLAIMS:

1. An air-bag, the air-bag comprising two superimposed layers of fabric, the layers of fabric being interconnected by means which define the outer periphery of the air-bag when in the unfolded state, one layer of fabric being provided with an aperture which is adapted to receive a gas generator, or means connected to a gas generator, there being a breakable seam inter-connecting the upper and lower layers of the fabric, said breakable seam defining a substantially triangular area which surrounds said aperture, the breakable seam incorporating at least one space between adjacent parts of the breakable seam.

2. An air-bag according to Claim 1 wherein the breakable seam is defined from a plurality of seam portions, there being a plurality of spaces between said adjacent seam portions.

3. An air-bag according to Claim 2 wherein the breakable seam portions comprise three seam portions, each seam portion being of substantially "V"-shape.

4. An air-bag according to Claim 2 or 3 wherein the seam portions define three linear sides of said triangular area, there being a space provided in the seam portions between the ends of each linear side of the triangular area.

5. An air-bag according to any one of the preceding Claims wherein the means which define the outer periphery of the bag comprise a peripheral seam, the peripheral seam and said breakable seam being formed simultaneously with

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the weaving of the fabric, threads from the upper and lower layers of fabric being inter-woven to form the peripheral seam and relatively weak threads, provided in at least one of the fabric layers, being inter-woven with the threads of the other of the fabric layers to form the breakable seam.

6. A method of folding an air-bag comprising the steps of taking an air-bag according to any one of the preceding Claims, turning the air-bag inside-out so that the air-bag has a triangular configuration defined by the shape of the breakable seam, and subsequently folding the air-bag with linear folds.

7. A method according to Claim 6, wherein the method comprises the subsequent steps of folding inwardly, towards the centre of the triangular configuration, flaps formed by the corner regions of the bag when in said triangular configuration.

8. A method according to Claim 7, wherein the flaps are folded inwardly about fold-lines, which fold-lines define the periphery of an area which is of triangular form and which has a shape and size corresponding substantially to the shape and size of each said flap.

9. A method according to Claim 7 wherein the flaps are folded inwardly about fold-lines, each flap being of such a size that the distance between the fold-lines of the flaps, along the sides of the bag when in said triangular configuration, is substantially equal to the length of each fold-line, the flaps thus being folded into a region which is substantially hexagonal.

10. An air-bag substantially as herein described with reference to and as shown in the accompanying drawings.

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11. A method of folding an air-bag substantially as herein described with reference to and as shown in Figures 1 to 5 of the accompanying drawings.

12. A method of folding an air-bag substantially as herein described with reference to and as shown in Figures 1 to 4 and 6 of the accompanying drawings.

13. An air-bag whenever folded by the method of any one of Claims 6 to 9 or 12.

14. Any novel feature or combination of features disclosed herein.

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The Patent Office

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Application No:	GB 9612616.4	**Examiner:**	J. C. Barnes-Paddock
Claims searched:	All	**Date of search:**	17 July 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7B (BSB)

Int Cl (Ed.6): B60R 21/16

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2,257,950 A	(MERCEDES-BENZ) Figs. 1,3; Page 3, para 3, Page 9, bottom line.	1-4
X	EP 0,686,527 A1	(TOYOTA) Fig.7, Col 5, lines 25-33	1-4,6
X	US 5,094,477	(IKEDA BUSSAN) Fig. 2,4, Col 3, lines 13-48	1-5
A	GB 2,257,952 A	(AIRBAGS INTERNATIONAL)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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